

EXHIBIT 4



US005767567A

United States Patent [19]**Hu et al.**

[11] **Patent Number:** **5,767,567**
 [45] **Date of Patent:** **Jun. 16, 1998**

[54] **DESIGN OF DEVICE LAYOUT FOR
INTEGRATION WITH POWER MOSFET
PACKAGING TO ACHIEVE BETTER LEAD
WIRE CONNECTIONS AND LOWER ON
RESISTANCE**

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 5,544,038 8/1996 Fisher et al .
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ABSTRACT

[21] Appl. No.: **707,929**

[22] Filed: **Sep. 10, 1996**

[51] Int. Cl.⁶ **H01L 23/495**

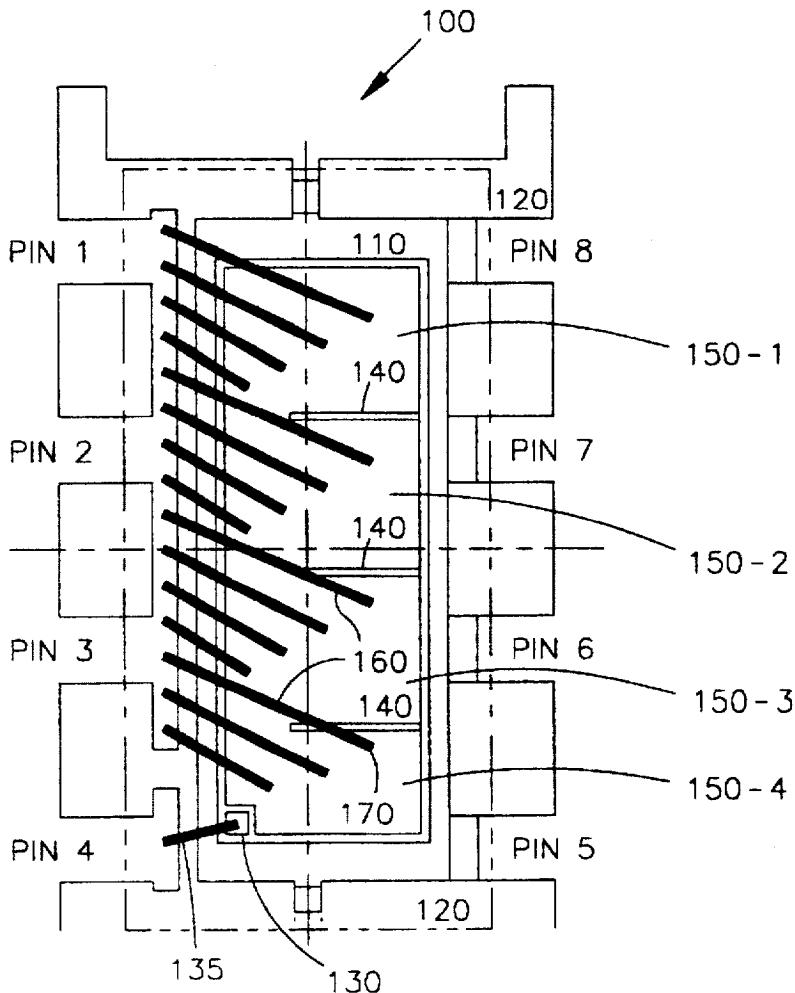
[52] U.S. Cl. **257/666; 257/401**

[58] Field of Search 257/401, 412,
257/330, 331, 153, 249, 666; 438/618,
617, 123

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8 Claims, 7 Drawing Sheets



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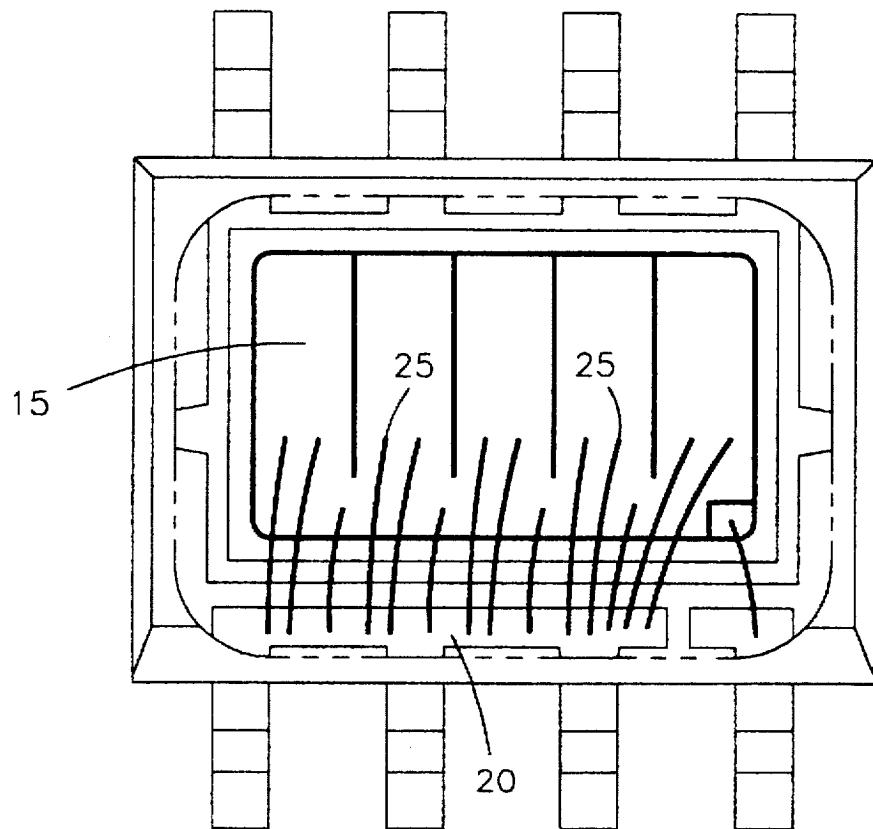


FIG. 1A
(PRIOR ART)

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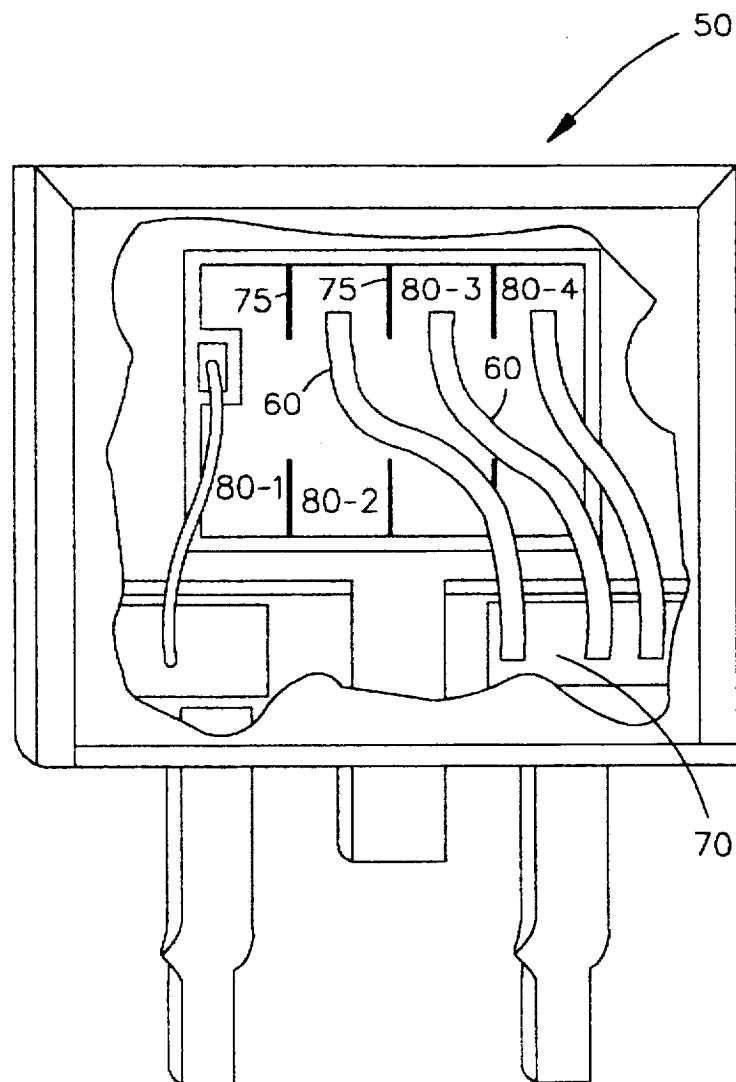


FIG. 1B
(PRIOR ART)

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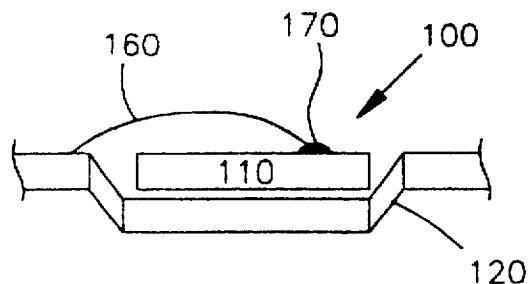


FIG. 2A

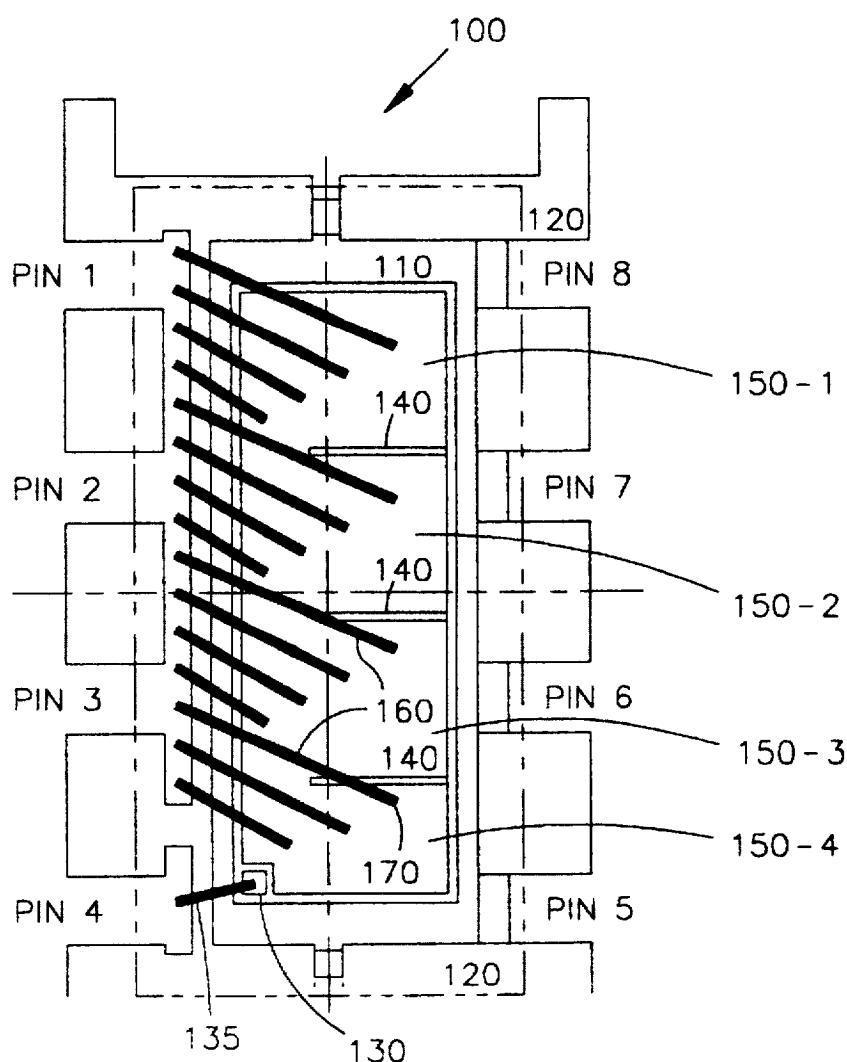


FIG. 2B

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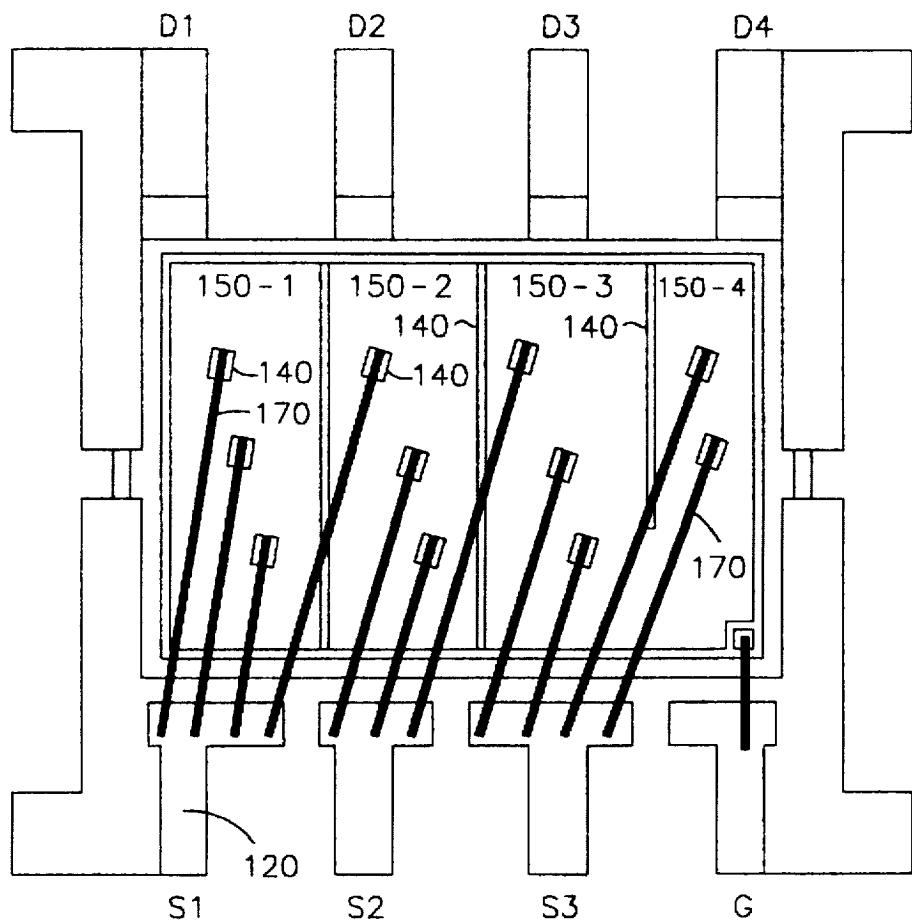


FIG. 2C

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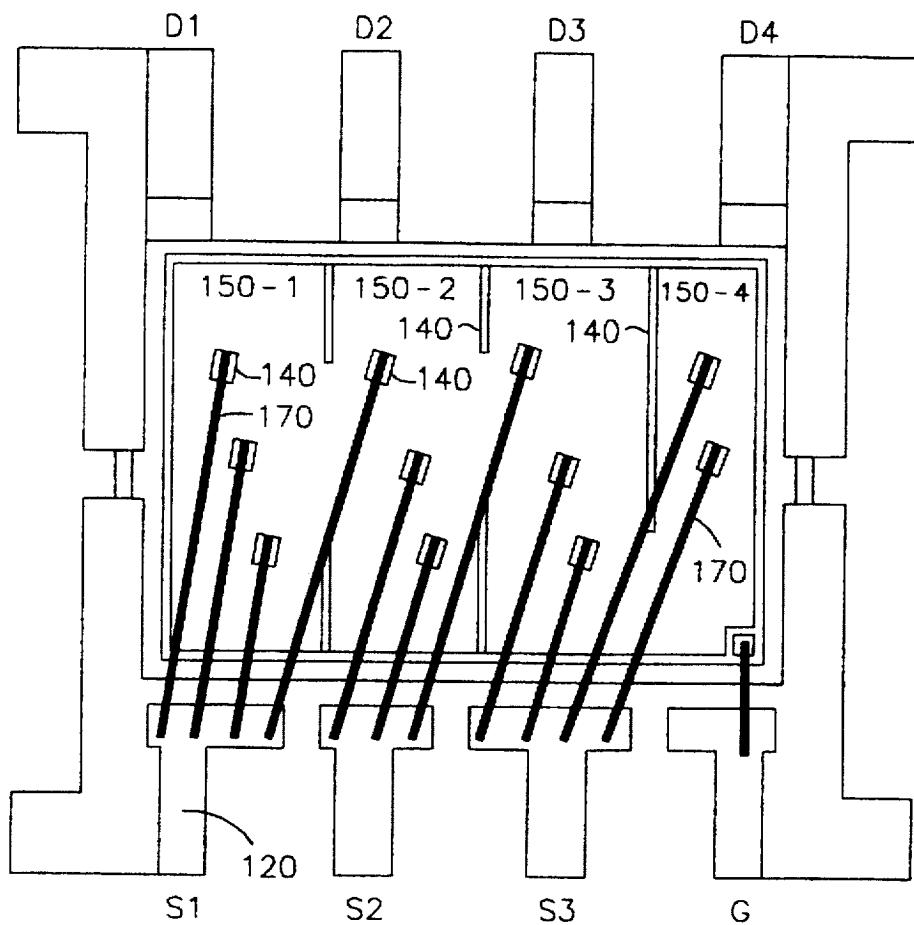


FIG. 2D

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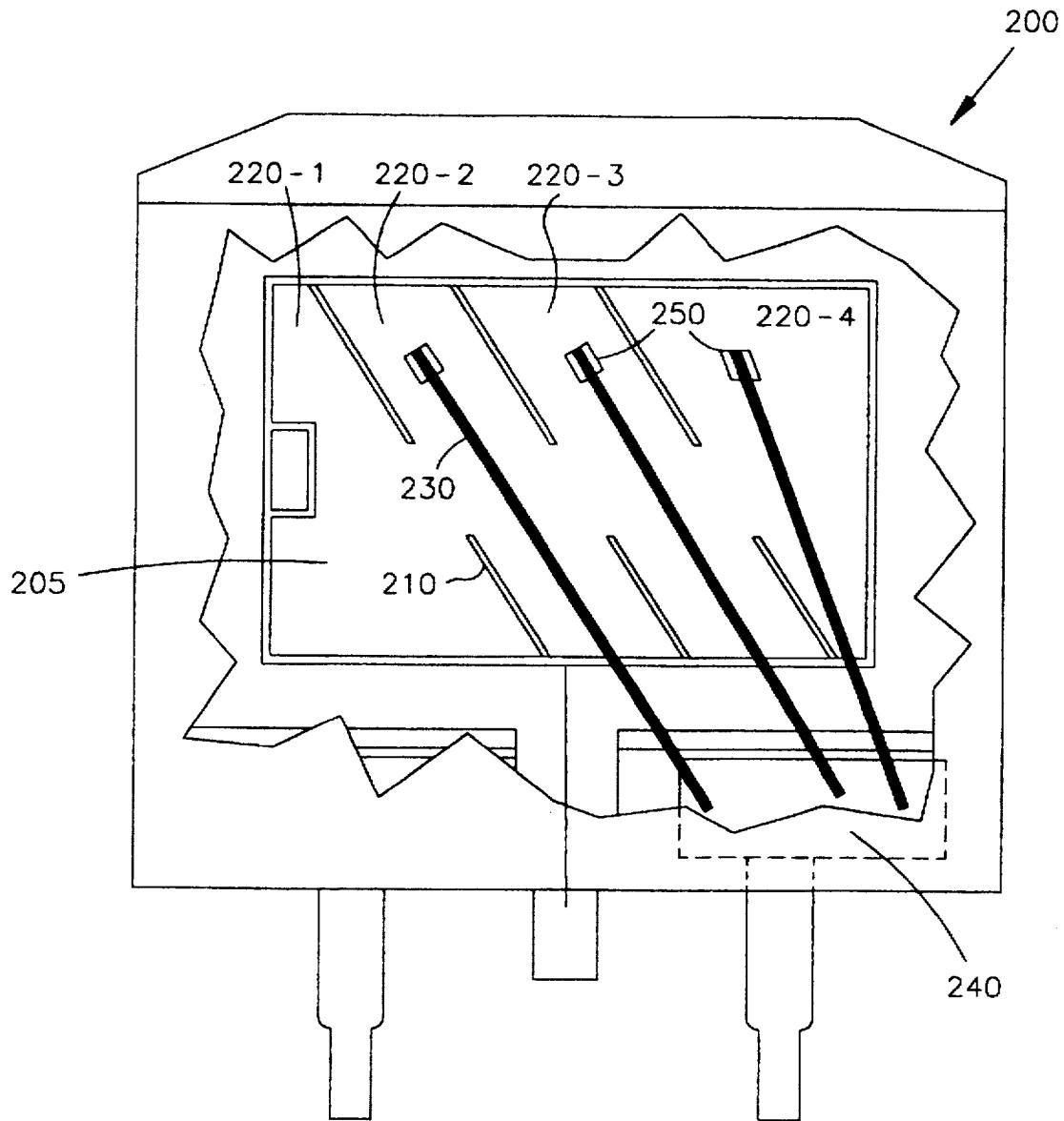


FIG. 3

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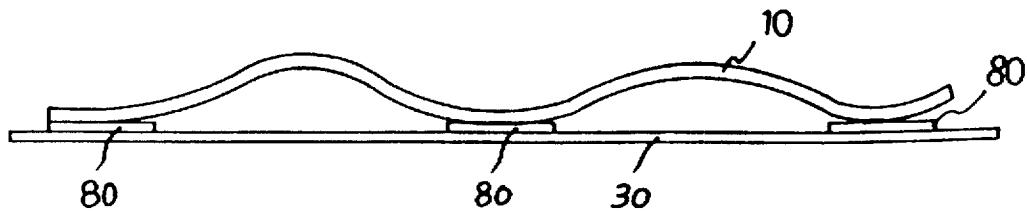


FIG. 4

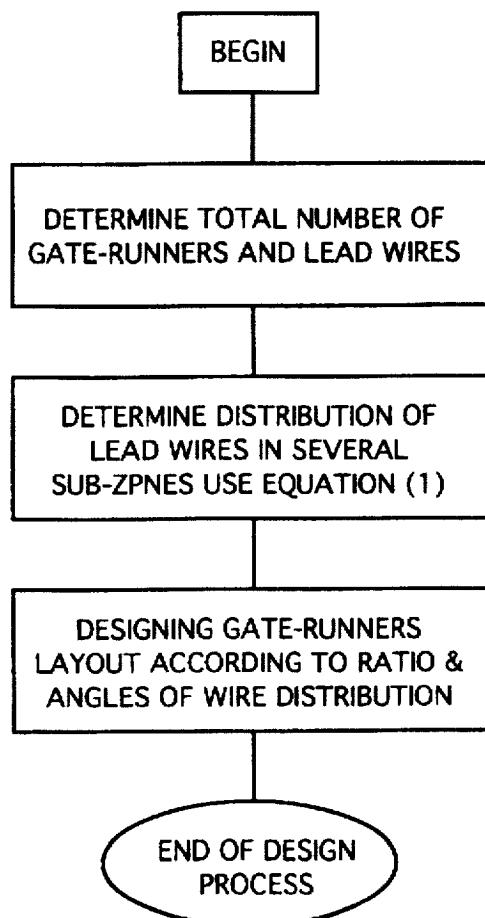


FIG. 5

**DESIGN OF DEVICE LAYOUT FOR
INTEGRATION WITH POWER MOSFET
PACKAGING TO ACHIEVE BETTER LEAD
WIRE CONNECTIONS AND LOWER ON
RESISTANCE**

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the device layout and packaging process of power MOSFETs. More particularly, this invention relates to a novel and improved device layout and packaging process for fabricating a power MOSFET device to achieve lower drain to source resistance by lowering the spreading resistance.

2. Description of the Prior Art

Conventional device layout and packaging configuration for fabricating a power metal oxide silicon field effect transistor (MOSFET) power device are limited by the technical difficulty that the on-resistance is increased due to the contact point arrangements of lead wires to the source contact. Specifically, conventional device layout and the lead-wire connection configuration of power MOSFETs, by the use of either gold wires or aluminum wires, result in higher spread resistance which leads to higher on-resistance.

The difficulty arises from the facts that the device layout of the power MOSFET is designed and manufactured before the transistor is packaged. However, in the process of packaging the transistor, additional lead wires are formed onto the transistor for making connection of the transistor with the pins on the package serving as means for providing external interface. In forming the lead wires onto the transistor contacts, the performance characteristics, e.g., the on-resistance, are impacted. Since the power MOSFET and the package are designed in two separate stages, the impacts on performance characteristics of the power MOSFET due to packaging processes are not taken into consideration in the design stage for the power MOSFET.

FIG. 1A shows a typical power MOSFET package 10 which includes a MOSFET device 15, i.e., the chip, connected to lead frames 20 by the use of lead wires 25, e.g., gold wires with a diameter of approximately 2 mils. The MOSFET device 15 includes a plurality of gate-metal stripes, i.e., the gate runners 30. The gate runners 30 divide the source contact surface into several equally divided areas, e.g., 35-1, 35-2, 35-3, 35-4, and 35-5. The lead wires 25 are then formed to connect the lead frames 20 to the surface of source contact, e.g., 35-1 to 35-5. For the convenience of fabrication and cost savings, the wires 25 are formed to disposed on the source contact surface near the lead frames 20 such that the wires are shorter and easier to maneuver in the wiring processes. However, since the wires 25 are not evenly distributed in the source contact surface, for a point, e.g., point 45, which is located in an area far away from the lead frame 20, there is a spread distance, Ls, between the wire-to-source contact point 40. A drain to source current initiated from the source underneath point 45 has to travel a longer spread distance Ls to reach the lead-to-source contact point 40. The longer the distance Ls, the greater the spread resistance Rs which is generally proportional to the length of the current path. The facts that the source contact surface 35-1 to 35-5 is equally divided by the gate runners 30 and that the lead-wires 25 are randomly formed on one end of the contact surface 35, cause a higher spread resistance thus unduly increasing the on-resistance of the MOSFET device 15 under this device layout and packaging configuration.

FIG. 1B shows another conventional packaging configuration for a power MOSFET device 50 which employs a

plurality of aluminum wires 60, which are typically wires of 15 mils in diameter, for connecting to the lead frames 70. Again, the gate runners 75 divide the source contact surface into equal areas 80-1 to 80-4. Due to the facts that wedge bonding process has to applied to bond the aluminum wires 60 to the source contact surface 80-1 to 80-4 and that the angle of the wire from the wedge bonding pad should be less than 60 degrees, the gate runners 75 are arranged to have middle openings to allow the aluminum wires 60 to turn an angle for making connection to the lead frame 70. However, in this configuration, again, the on resistance for the MOSFET device 50 is increased due to the fact that the contact points between the aluminum wires 60 and the source contact surface 80-1 to 80-4 are unevenly distributed. These contact points are long distance away from some source contact points which leads to high spread resistance and in turn causing the on-resistance to increase.

Therefore, there is still a need in the art of power device fabrication, particularly for power MOSFET design and fabrication, to provide a improved design for device layout for integration with the MOSFET packages such that these limitations and difficulties can be resolved.

SUMMARY OF THE PRESENT INVENTION

It is therefore an object of the present invention to provide an improved design for device layout of the power MOSFET to overcome the aforementioned difficulties encountered in the prior art.

Specifically, it is an object of the present invention to provide an improved MOSFET device layout and packaging configuration wherein novel gate runner and source contact topology are arranged to evenly distribute the wire lead contacts thus lowering the spread resistance and the on-resistance.

Another object of the present invention is to provide an improved MOSFET device layout and packaging configuration where the source contact areas divided by the gate runners are flexibly arranged to be proportional to the number of the lead contacts formed in each divided area such that the lead wire contacts are more evenly distributed on the surface of the source contact.

Another object of the present invention is to provide an improved MOSFET device layout and packaging configuration wherein the layout of the gate runners and the source contact areas are flexibly arranged for integrating with the lead wire and lead frame configuration such that the lead wires for source contact connections can be optimally formed to reduce the spread resistance.

Another object of the present invention is to provide an improved MOSFET device layout and packaging configuration wherein the layout of the gate runners and the source contact areas are flexibly arranged which are more suitable for wedge bonding when the aluminum lead wires are employed to simplify the fabrication process and to lower the on resistance.

Briefly, in a preferred embodiment, the present invention includes a MOSFET power integrated circuit (IC) device disposed in a semiconductor chip including a source contact area which is provided for connecting to a lead-frame via a plurality of lead-wires. The power IC device includes a plurality of lead-wire contact points disposed on the source contact area for securely attaching the lead wires thereon wherein the lead-wire contact points are disposed substantially in a uniform distribution over the source contact area.

In an alternate preferred embodiment, this invention discloses a power integrated circuit (IC) device disposed in a

semiconductor chip including a source contact area provided with a plurality of lead-wire contact points thereon for connecting to a lead-frame via a plurality of lead-wires to be securely attached to the source contact area on each of the lead-wire contact points. The IC device includes a plurality of gate runners disposed on the source contact area thus dividing the source contact area into several sub-contact areas wherein the several sub-contact areas are arranged with different sizes for substantially distributing the lead-wire contact points uniformly over the source contact area.

In yet another preferred embodiment, this invention discloses an integrated circuit (IC) power device disposed in a semiconductor chip including a source contact area provided with a plurality of lead-wire contact points thereon for connecting to a lead-frame via a plurality of lead-wires to be securely attached to the source contact area on each of the lead-wire contact points. The power IC device includes a plurality of gate runners disposed on the source contact area thus dividing the source contact area into several sub-contact areas with slant angles for alignment with the lead-wires for connecting to the lead-frames.

These and other objects and advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiment which is illustrated in the various drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A and 1B are top views showing conventional device layout and packaging configurations for power MOSFET employing gold wires and aluminum wires respectively;

FIGS. 2A to 2D are the cross sectional view and top view respectively of a novel device layout and packaging configuration for a power MOSFET of the present invention;

FIG. 3 is a top view showing a novel device layout with the gate runners slanted toward the lead frames thus dividing the source contact area into slanted sub-regions and more suitable to form wedge bond in the sub-region for the aluminum wires;

FIG. 4 is a cross sectional view of the aluminum wire with stitch contacts distributed over the source contact areas to evenly distribute the contact points thus reducing the spread resistance; and

FIGS. 5 is a flow chart showing the design process for design the device layout with different gate runner arrangements to achieve optimal packaging and device performance characteristics.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Please refer to FIGS. 2A and 2B for a cross sectional view and top view respectively of a power MOSFET device 100 with novel topology of the gate-runner arrangement. The MOSFET device 100, i.e., the chip, is mounted on a die pad 110 surrounded by lead frames 120. The lead frames 120 are then connected to different pins, e.g., pin 1 to pin 8 as shown, for external interface. The MOSFET device 100 includes a gate contact 130 which is connected to pin 4 with a lead wire 135. The MOSFET device 100 further includes a plurality of gate runners 140 which divide the source contact 150 into several source contact areas, e.g., source contact areas 150-1, 150-2, 150-3, and 150-4. A plurality of lead wires 160 are then formed for connecting the source contact 150 to the lead frames 120. According a principle of this invention, in

order to reduce the spread resistance, the topology of the gate runner 140 specially arranged according to the location of the lead frames and the external pins, e.g., pin 1 to pin 4, for dividing the source contact areas 150-1 to 150-4 to source contact areas of unequal sizes. Furthermore, the contact points 170, where the lead wires 160 are connected to the source contact 150, are spread out in each of the contact areas 150-1 to 150-4. The division of the contact areas 150-1 to 150-4 and the spread of the contact points 170 between the lead wire 160 to source contact 150 are arranged to achieve reduced spread resistance. The number of gate runners 140 depends on the device characteristics. For large devices, more gate runners 140 are used to reduce the gate resistance and improve the switching speed. In addition to the number, i.e., N_{GR} , of gate runners 140, the ratio of the contact areas for uniformly distributing the wires 160 in several contact area divided by the gate runners 140 also depends on the number, i.e., N_{LW} , of the lead wires 160. In general, the number N_{LW} of lead wire wires 160 is determined by: a) the number of wires the device needs, i.e., N_{NEED} and b) the number of wires the lead frame can accommodate, i.e. N_{FRAME} .

$$N_{LW} = \text{Minimum}\{N_{NEED}, N_{FRAME}\} \quad (1)$$

A basic number of wires to be distributed in each of the contact areas N_{BASIC} is:

$$N_{BASIC} = \text{Integer of}\{N_{LW}/(N_{GR}+1)\} \quad (2)$$

and

$$N_{LW} = (N_{GR}+1)N_{BASIC} + N_{REMAINDER} \quad (3)$$

Where $N_{REMAINDER}$, i.e., the remainder of equal distribution, has an integer value ranging between zero and $(N_{BASIC}-1)$. In order to more evenly distribute the lead wires 160 into $(N_{GR}+1)$ contact areas, a simple basic rule is established to divide the lead wires into $(N_{GR}+1)$ groups where:

$$N_{LW} = N(1) + N(2) + \dots + N(K) + N(K+1) + \dots + N(GR+1) \quad (4)$$

Where $N(1)=N(2)=N(3)=\dots=N(K)=N_{BASIC}$, and $N(K+1)=N(K+2)=\dots=N(GR+1)=(N_{BASIC}+1)$ and $K=(N_{GR}+1)-N_{REMAINDER}$. The above basic rule can be easily understood with an example, for instance, the total number of lead wires, i.e., N_{LW} , is 19, the number of gate runners N_{GR} is 4, a basic equal distribution is N_{BASIC} is 3 and a remainder of equal distribution $N_{REMAINDER}$ is 4. The lead wires are distributed into five groups with a distribution ratio of $\{3:4:4:4:4\}$, i.e., a distribution according to Equation (4), where $K=(4+1)-4=1$ and $(N_{BASIC}+1)=4$. Based on this ratio, the contact areas 150 are then divided by the gate runners 140 to have substantially the same ratio.

In the preferred embodiment shown in FIGS. 2A and 2B, with three gate runners 140, the source contact area 150 are divided, according to the above basic equal distribution rule, into four sub-contact areas having a proportion of approximately 4:4:4:3 between the contact areas 150-1 to 150-4. The lead wire 160 are then arranged to spread out in each of the contact areas 150-1 to 150-4. A simplified method is applied to spread the lead wire contact points 170 in each of the contact source areas 150-1 to 150-4 by dividing the width, i.e., W, and length, i.e., L, into equal segments of ΔX and ΔY , i.e., $\Delta X=W/N$ and $\Delta Y=L/N$, and then placing the contact points 170 on the point $(k\Delta X, k\Delta Y)$ where $k=1$ to N and N is the number of wire leads placed into that area, e.g., $N=4$ for source contact areas 150-1 to 150-3, and $N=3$ for

source contact area 150-3. By spreading the points of contact 170 in each of these areas, for a power MOSFET device 100 of size of W=98 mils and L=160 mils (which have die pad size of approximately 106 mils by 166 mils), the spread resistance is reduced from a range of 12 to 15 milli-ohms to approximately 7 to 10 milli-ohms. The improvement in spread resistance may depend on the device characteristics. For a 30-volts device, about ten to twenty percents (10%-20%) of the total on-resistance are caused by the spread resistance, while the percentage for a lower 12-volts device can be as high as thirty to fifty percents (30-50%) due to the spread resistance. Generally, by applying the design rules disclosed in this invention, greater improvements in performance are achieved for lower voltage device.

FIGS. 2C and 2D are top views of two alternate embodiments of a power MOSFET device similar to that shown in FIGS. 2A and 2B, except that the gate runners 140 are arranged differently. These types of gate runner arrangements are implemented for die size reduction and speed improvement.

Therefore, in a preferred embodiment, the present invention includes a MOSFET power integrated circuit (IC) device 100 disposed in a semiconductor chip 110 including a source contact area 150 which is provided for connecting to a lead-frame 120 via a plurality of lead-wires 160. The power IC device includes a plurality of lead-wire contact points 170 disposed on the source contact area 150 for securely attaching the lead wires 160 thereon wherein the lead-wire contact points 170 are disposed substantially in a uniform distribution over the source contact area 150.

In an alternate preferred embodiment, this invention discloses a power integrated circuit (IC) device 100 disposed in a semiconductor chip 110 including a source contact area 150 provided with a plurality of lead-wire contact points 170 thereon for connecting to a lead-frame 120 via a plurality of lead-wires 160 to be securely attached to the source contact area 150 on each of the lead-wire contact points 160. The IC device includes a plurality of gate runners 140 disposed on the source contact area 150 thus dividing the source contact area into several sub-contact areas 150-1, 150-2, 150-3, and 150-4 wherein the several sub-contact areas 150-1 to 150-4 are arranged with different sizes for substantially distributing the lead-wire contact points 170 uniformly over the source contact area 150.

This invention also discloses a method to configure a source contact area 150 on a power MOSFET device 100 by dividing said source contact areas 150 with several gate runners 140 disposed thereon, the method including steps of: (a) determining a total number of lead wires 160 for connecting to a lead frame 120 from the source contact area 150 on the MOSFET power device 100; and (b) configuring the gate runners 140 for dividing the source contact area 150 into several sub-contact areas 150-1 to 150-4 with a set of area proportional ratios, e.g., 4:4:4:3, for disposing several of the lead wires 160 in each of the sub-contact areas 150-1 to 150-4 according to the set of area proportional ratios, e.g., 4:4:4:3.

Please refer to FIG. 3 for a top view showing a novel device layout and packaging configuration for a power MOSFET 200 of the present invention. The power MOSFET device 200 includes a plurality of gate runners 210 which divide the source contact area into a plurality of sub-regions, e.g., sub-regions 220-1, 220-2, 220-3, and 220-4. In each sub-region, there is a aluminum wire 230 connecting the source contact area 220-2 to 220-4 to a lead frame 240 surrounding the MOSFET chip 205. The device layout is modified to align with a angular slant toward the lead frame

240 such that it is easily integratable with lead frame 240. Specifically, the aluminum wire 230 in this layout can be formed in each of these contact sub-regions 220-1 to 220-4 with a wedge bonding directed to the lead frame 240. The aluminum wire 210 can therefore be formed by employing a wedge bonding 250 without an angular turn as that required in the prior art. More reliable packaging is achieved because the straight wire arrangement.

Thus, this invention discloses an integrated circuit (IC) power device 200 disposed in a semiconductor chip 205 including a source contact area 220 provided with a plurality of lead-wire contact points 250 thereon for connecting to a lead-frame 240 via a plurality of lead-wires 230 to be securely attached to the source contact area 220 on each of the lead-wire contact points 250. The power IC device 200 includes a plurality of gate runners 210 disposed on the source contact area 220 thus dividing the source contact area into several sub-contact areas 220-1, 220-2, 220-3, and 220-4 with slant angles for alignment with the lead-wires 230 for connecting to the lead-frames 240.

Please refer to FIG. 4 for additional improvement to reduce the MOSFET spread resistance of the aluminum wire connection. Instead of a single aluminum wire contact point to the source contact surface 220-4 to 220-4, the aluminum wire are formed to have "stitch contacts" 250 with the source contact areas 220-2 to 220-4. The purpose of the stitch contacts is to generate more points of wire-source contact such that the contact points 250 are more evenly distributed in each of the source contact sub-regions 220-1 to 220-4.

The spread resistance is therefore reduced with more numerous and more evenly distributed contacts in each sub-regions.

The basic design rule is to evenly distribute the wires 230 and the contact points 250 over the contact areas 220-1 to 220-4 which are divided by the gate runners 210. Typically, for a device package which employs aluminum wires 230, only one to two wires are distributed in each slanted contact area, e.g., 220-2 to 220-4. The distance between stitch contact points 250 can be flexibly arranged depending on the machine capability and the production costs involved in making these stitch contacts. The stitch contact points can be formed for each aluminum wire 230 to have distance of several mils or with even smaller distance. A measurable improvements of five to almost twenty percents (5-20%) of the spread resistance, and thus correspondingly the on-resistance, are achievable because of the more uniform distribution of the contact points over the source contact areas.

Referring to FIG. 5 for a flow chart for design the layout configuration of a source contact area 150. To start the design process (step 300), the total number N_{GR} of gate runners 140 and the lead wires 160, i.e., N_{LW} , for connecting to a lead frame 120 are first determined (step 310). The ratios of lead wires 160 to be distributed in $N_{GR}+1$ sub-contact regions, e.g., 150-1 to 150-4, are then computed according to Equations (1) to (4), (step 320). The layout of the gate runners 140 are then designed (step 330) according to the ratios determined in step 320. Similarly, for designing a layout of the source contact area when the aluminum wires 230 are employed, the slant angles of the lead wires are first determined based on the relative location of the chip and lead frame. Then the layout of the gate runners are determined to comply with the slant angles required for the wedge bonding pads used for attaching the aluminum lead wires such that the lead wire twist may be minimized.

Therefore, the present invention provides an improved design for device layout and packaging configuration for

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manufacturing the power MOSFET to overcome the difficulties encountered in the prior art. Specifically, an improved MOSFET device layout and packaging configuration are provided wherein novel gate runner and source contact topology are arranged to evenly distribute the lead wire contacts on the source contact surface thus lowering the spread resistance and the on-resistance. The source contact areas divided by the gate runners are now flexibly arranged to be proportional to the number of the lead contacts formed in each divided area such that the lead wire contacts are more evenly distributed on the surface of the source contact. The gate runners and the source contact areas are flexibly arranged for integrating with the lead wire and lead frame configuration such that the lead wires for source contact connections can be optimally formed with the packaging configuration to reduce the spread resistance. In a MOSFET device package where aluminum wires are employed, the gate runners and the source contact areas are flexibly arranged with an angular slant toward the lead frame which are more suitable for wedge bonding. Furthermore, stitch contacts are formed to more evenly distributed the contact points on the source contact surface such that the spread resistance can be reduced.

Although the present invention has been described in terms of the presently preferred embodiment, it is to be understood that such disclosure is not to be interpreted as limiting. Various alternations and modifications will no doubt become apparent to those skilled in the art after reading the above disclosure. Accordingly, it is intended that the appended claims be interpreted as covering all alternations and modifications as fall within the true spirit and scope of the invention.

We claim:

1. A power integrated circuit (IC) device disposed in a semiconductor chip including a source contact area provided with a plurality of lead-wire contact points thereon for connecting to a lead-frame via a plurality of lead-wires to be securely attached to said source contact area on each of said lead-wire contact points, said IC device comprising:

a plurality of gate runners disposed on said source contact area thus dividing said source contact area into several sub-contact areas wherein said several sub-contact areas are arranged with different sizes for substantially distributing said lead-wire contact points uniformly over said source contact area.

2. A power integrated circuit (IC) device disposed in a semiconductor chip including a source contact area provided with a plurality of lead-wire contact points thereon for connecting to a lead-frame via a plurality of lead-wires to be securely attached to said source contact area on each of said lead-wire contact points, said IC device comprising:

a plurality of gate runners disposed on said source contact area thus dividing said source contact area into several sub-contact areas with slant angles for alignment with said lead-wires for connecting to said lead-frames.

3. The integrated circuit (IC) power device of claim 2 wherein:

each of said lead wires for connecting to said lead frames includes several stitch contact points attaching to a top

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surface of said source contact area thus increasing said lead wire contact points disposed on said source contact area.

4. The integrated circuit (IC) power device of claim 2 wherein:

each of said lead wires is an aluminum wire and each of said lead wire contact points includes a wedge bonding pad for securely attaching said aluminum wires to said top surface of said source contact area.

5. A MOSFET power device disposed in a semiconductor chip including a source contact area provided with a plurality of lead-wire contact points thereon for connecting to a lead-frame via a plurality of lead-wires to be securely attached to said source contact area on each of said lead-wire contact points, said IC device comprising:

a plurality of gate runners disposed on said source contact area thus dividing said source contact area into several sub-contact areas wherein said several sub-contact areas are arranged with different sizes for substantially distributing said lead-wire contact points uniformly over said source contact area.

6. The MOSFET power device of claim 5 wherein:

said plurality of gate runners disposed on said source contact area dividing said source contact area into several sub-contact areas of substantially equal size for disposing an evenly-distributed equal number of said lead wire contact points therein with a remainder number of sub-contact areas having smaller areas for disposing a less lead wire contact points therein wherein said less wire contact points being one less than said evenly distributed equal number of said wire contact points.

7. A method to configure a source contact area on a power MOSFET device by dividing said source contact areas with several gate runners disposed thereon, said method including steps of:

(a) determining a total number of lead wires for connecting to a lead frame from said source contact area on said MOSFET power device; and

(b) configuring said gate runners for dividing said source contact area into several sub-contact areas with a set of area proportional ratios for disposing several of said lead wires in each of said sub-contact areas according to said set of area proportional ratios.

8. A method to configure a source contact area on a power MOSFET device by dividing said source contact areas with several gate runners disposed thereon, said method including steps of:

(a) determining a total number of lead wires and angles of bonding pads for connecting to a lead frame from said source contact area on said MOSFET power device; and

(b) configuring said gate runners according said total number of lead wires and said angles of bonding pads for designing a layout of said gate runners in said source contact area.

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EXHIBIT 5

TOWNSEND
and
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and
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September 12, 2007

VIA ELECTRONIC MAIL AND U.S. MAIL

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Re: Alpha & Omega Semiconductor, Ltd. v. Fairchild Semiconductor Corp.,
Case No. C 07-2638 JSW (consolidated with Case No. C-07-2664 JSW)
Our File No.: 18865P-021600

Dear Brett:

This letter concerns AOS's Disclosure of Asserted Claims and Preliminary Infringement Contentions Pursuant to Patent L.R. 3-1 ("PICs") served on August 31, 2007.

AOS's PICs fail to provide the required disclosure under Patent L.R. 3-1. The overriding principle of the Patent Local Rules is to streamline the discovery process and make it more efficient by requiring a plaintiff to articulate its claims with specificity. *See Intertrust Technologies Corp. v. Microsoft Corp.*, 2003 WL 23120174, *1 (N.D. Cal. 2003). The intent of the rule is to "require parties to crystallize their theories of the case early in the litigation" and to adhere to those theories once they have been disclosed. *Id.* (citation omitted); *O2 Micro Intern. Ltd. v. Monolithic Power Sys, Inc.*, 467 F.3d 1355, 1364 (Fed. Cir. 2006) (citation omitted). AOS's PICs fail to provide the required disclosure in at least the following ways.

First, Patent L.R. 3-1(c) requires AOS to provide a chart "identifying specifically where each element of each asserted claim is found within each Accused Instrumentality." AOS's PICs are completely devoid of any specific information identifying anything in the accused products or methods that allegedly practices the elements of the asserted claims. AOS's entire disclosure appears to consist merely of parroting back the language of each claim element with an accompanying assertion that Fairchild's accused methods or products include that claim element, without any supporting analysis or evidence. For example, below is the disclosure for the claim element identified by AOS as element (b) of claim 1 of U.S. Patent No. 5,907,776 ("the 776 Patent"):

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(b) forming at least one trench in said substrate;	The Accused '776 Patent Methods include the step of forming at least one trench gate in the aforementioned substrate.
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AOS has merely taken the language of the claim element from the first column ("forming at least one trench in said substrate"), parroted it back in the second column ("... the step of forming at least one trench gate in the aforementioned substrate") and included introductory language that asserts without any basis that the accused methods include this step. This disclosure does not provide sufficient information to articulate AOS's claims or theories of infringement as required by the Northern District of California Patent Local Rules or case law. *See Intertrust*, 2003 WL 23120174, *1; *O2 Micro*, 467 F.3d at 1364.

AOS follows the same formula for the other claim elements of the '776 Patent. For example, below is the disclosure for the claim element identified by AOS as element (d) of claim 13 of the '776 Patent:

(d) compensating a portion of said body region by implanting material of said second conductivity type in said body region	The Accused '776 Patent Methods include the step of compensating a portion of the aforementioned body region. This step includes at least implanting dopants of the same conductivity type as the aforementioned source region.
--	---

The disclosure for the only asserted claim of U.S. Patent No. 5,767,567 ("the "567 Patent) is similarly devoid of any substance. For example, below is the disclosure for the claim element identified by AOS as element (b) of claim 7 of the '567 Patent:

(b) configuring said gate runners for dividing said source contact area into several sub-contact areas with a set of area proportional ratios for disposing several of said lead wires in each of said sub-contact areas according to said set of area proportional ratios.	The Accused '567 Patent Methods include the step of dividing the source contact area with the one or more gate runners into two or more subsections. The subsections of the source contact area are divided so that they are of proportional ratios for disposing the lead wires in accordance with the ratios.
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This disclosure also does not provide sufficient information to articulate AOS's claims or theories of infringement as required by the Northern District of California Patent Local Rules or case law. *See Intertrust*, 2003 WL 23120174, *1; *O2 Micro*, 467 F.3d at 1364.

Finally, Patent L.R. 3-1(f) requires that AOS identify "separately for each asserted claim," each AOS apparatus, produce, device, method, act, or other instrumentality that incorporates or reflects "that particular claim." AOS has provided in Exhibit C a list of AOS products that it alleges practice the claimed inventions, but did not identify which AOS products are alleged to practice which asserted claims.

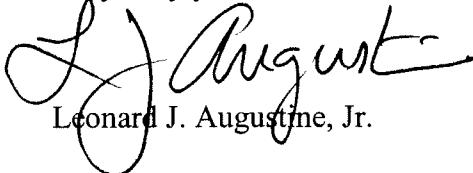
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Rule 11 of the Federal Rules of Civil Procedure requires a party to conduct a reasonable inquiry into the applicable facts and law before filing a document, to include "investigat[ing] the factual and legal basis for the complaint before filing suit." *Network Caching Technology, LLC v. Novell, Inc.*, 2002 WL 32126128, *4 (N.D. Cal.) (granting in part motion to strike PICs). In applying Rule 11 to Patent L.R. 3-1, "a plaintiff must put forth information so specific that either reverse engineering or its equivalent is required." *Intertrust*, 2003 WL 23120174, *2. AOS's PICs clearly fall short of the required disclosure.

Please provide amended PICs that comply with the requirements of the Patent Local Rules within the next seven days. Fairchild's Preliminary Invalidity Contentions are due within 45 days of service of AOS's Preliminary Infringement Contentions, and we interpret that to mean service of contentions that comply with the Patent Local Rules.

Very truly yours,



Leonard J. Augustine, Jr.

LJA/lja

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61150435 v1

EXHIBIT 6

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 Tel: 650.843.4000
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www.morganlewis.com



Andrew J. Wu
 Partner
 650.843.7511
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September 21, 2007

VIA E-MAIL AND U.S. MAIL

Leonard J. Augustine, Jr.
 Townsend and Townsend and Crew LLP
 Two Embarcadero Center
 Eighth Floor
 San Francisco, CA 94111-3834

Re: *Alpha & Omega Semiconductor, Ltd. et al. v. Fairchild Semiconductor Corp.*,
 Case No. C 07-2638 JSW (consolidated with Case No. C 07-2664 JSW)

Dear Mr. Augustine:

I write in response to your letter to Brett Schuman dated September 12, 2007 regarding AOS's Disclosure of Asserted Claims and Preliminary Infringement Contentions ("PICs"). We disagree with your contentions regarding AOS's PICs, and we have a number of issues with Fairchild's Patent L.R. 3-1 Disclosures.

In your letter, you contend that "AOS's PICs are completely devoid of any *specific information* identifying anything in the accused products or methods that allegedly practices the elements of the asserted claims." (emphasis added). We disagree. Significantly, AOS has identified specific Fairchild products—by part number—that are believed to be manufactured using methods disclosed by the asserted patents. Furthermore, for each of the methods that are believed to be used in the manufacture of these products, AOS has provided a chart identifying—on an element-by-element basis—where in the accused products or processes the claim elements are found. In some instances, the description of the step happens to coincide with the claim language in large part because that is the language that describes the step, *e.g.*, "providing a substrate" or "forming a trench."

Indeed, AOS's disclosures use very similar language to the language Fairchild used in its own PICs. For example, Fairchild's PICs include the following language (Exhibit 30):

Leonard J. Augustine, Jr.
September 21, 2007
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forming a plurality of trenches extending to a first depth into the semiconductor substrate;	The accused method includes creating a plurality of trenches that extend to a predetermined depth into the substrate (a first depth). (Fig. AO4812-3 (Scanning Electron Microscopy image), item B; Fig. AO4812-4 (Scanning Capacitance Microscopy image), item B.)
--	--

This disclosure parallels the AOS disclosure you identify as faulty in your letter:

(b) forming at least one trench in said substrate;	The Accused '776 Patent Methods include the step of forming at least one trench gate in the aforementioned substrate.
--	---

In light of the similarities between the parties' disclosures, it is difficult for AOS to understand the issues Fairchild has raised with respect to AOS' claims charts.

Moreover, as noted in AOS's PICs, AOS provided the PICs prior to receiving any discovery for Fairchild. Accordingly, AOS cannot be expected to identify at this stage of the litigation the steps or elements of Fairchild's processes using the specific language that Fairchild uses to refer to those steps, or to correlate the claim elements to the steps as described in Fairchild's processing recipes or other documents.

Fairchild's own PICs include far more significant flaws, and fail to comply with Patent L.R. 3-1. For example, Fairchild's identification of the AOS products that Fairchild accuses of infringement does not appear to be a good faith identification complying with the appropriate rules. Fairchild states that every product listed in AOS's "all products" selection guide infringes every accused Fairchild claim. This "shotgun" identification is starkly inconsistent with the statement in your letter that "the overriding principle of the Patent Local Rules is to streamline the discovery process," and is particularly improper given that Fairchild only provides claim charts for a handful of products, with no suggestion of how those charts justify assertions that every other AOS product infringes. Further, in its pre-litigation correspondence, Fairchild only identified certain AOS products. Fairchild must limit its accusation to those products that it in good faith believes infringe its patents.

Also, with respect to Fairchild's disclosure under Patent L.R. 3-1(f), Fairchild has not identified specific products that practice the asserted claims, but simply states "PowerTrench MOSFETS." Fairchild must amend its Patent L.R. 3-1(f) disclosure to identify specific products, and not just categories of products, that reflect each of the asserted claims.

Finally, the exhibits to Fairchild's Patent L.R. 3-1 Disclosures are also improper. Fairchild includes various analyses purportedly supporting the accusations of its claim charts, including SEMs, SCMs, and SIMS analyses. Fairchild, however provides no information or

Morgan Lewis
COUNSELORS AT LAW

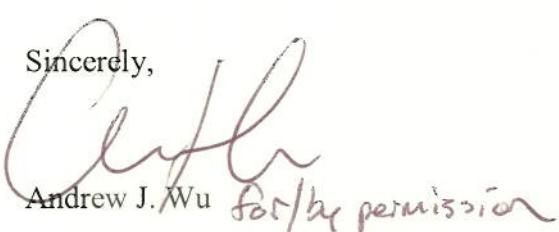
Leonard J. Augustine, Jr.
September 21, 2007
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documentation regarding these purported analyses, including documents explaining what products were analyzed, the parameters of the analyses, how the images were generated, etc. For example, it is not clear if the SIMS images are taken from a single analysis or are created from a compilation of analyses, nor is it even clear what part of the device is being analyzed. Even more strikingly, for some of the products, Fairchild provides analysis for a product, and then acknowledges that the analysis is actually of a different product. Further, we suspect that at least one of the parts identified is not even an AOS product.

Indeed, we invite you to review the analyses included in Fairchild's Patent L.R. 3-1 disclosures and confirm that you believe the products infringe, since it appears that some of the products do not infringe even under what we suspect is Fairchild's theory of infringement.

Please let me know your thoughts on these matters. Thank you.

Sincerely,



Andrew J. Wu for/b^y permission

EXHIBIT 7

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 and
 TOWNSEND
 and
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 LLP

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September 26, 2007

VIA ELECTRONIC MAIL AND U.S. MAIL

Andrew J. Wu
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 awu@morganlewis.com

Re: Alpha & Omega Semiconductor, Ltd. v. Fairchild Semiconductor Corp.,
 Case No. C 07-2638 JSW (consolidated with Case No. C-07-2664 JSW)
Our File No.: 18865P-021600

Dear Mr. Wu:

I write in response to your letter of September 21, 2007 concerning AOS's Disclosure of Asserted Claims and Preliminary Infringement Contentions Pursuant to Patent L.R. 3-1 ("PICs") served on August 31, 2007.

As detailed in my September 12, 2007 letter to Brett Schuman, AOS's PICs fail to provide the required disclosure under Patent L.R. 3-1 with respect to U.S. Patents No. 5,767,567 and 5,907,776. The PICs fail to provide charts "identifying specifically where each element of each asserted claim is found within each Accused Instrumentality" under Patent L.R. 3-1(c). The PICs instead merely parrot back the language of each asserted claim without any supporting analysis or evidence identifying where the elements of the asserted claims are found in Fairchild's products and methods. The PICs further fail to identify "separately for each asserted claim, each [] apparatus, product, device, process, method, act or other instrumentality that incorporates or reflects that particular claim" under Patent L.R. 3-1(f). The PICs thus fail to provide the required disclosure of AOS's infringement theories as required under the Patent Local rules. *See e.g., Intertrust Technologies Corp. v. Microsoft Corp.*, 2003 WL 23120174, *1 (N.D. Cal. 2003); *O2 Micro Intern. Ltd. v. Monolithic Power Sys., Inc.*, 467 F.3d 1355, 1364 (Fed. Cir. 2006) (citation omitted).

Your assertion that AOS "uses very similar language to the language Fairchild used in its own PICs" in its claim charts is wrong and conveniently misses the point. Fairchild's claim

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charts cite to evidence that shows how AOS's products and methods infringe Fairchild's patent claims, while AOS's claim charts cite no evidence with respect to Fairchild's products and methods.

The excerpts you cite in an attempt to show that Fairchild's PICs disclosure is "similar" to AOS's only underscore how different Fairchild's disclosure is from AOS's: the excerpted Fairchild Exhibit 30 claim element includes a citation to both a Scanning Electron Microscopy image and a Scanning Capacitance Microscopy image that were attached as exhibits to Fairchild's claim charts, each of which show how AOS's accused methods include that claim element. By contrast, the excerpted AOS claim element provides no citation to any evidence. Your letter acknowledges that Fairchild has supported its PICs with such evidence ("Fairchild includes various analyses purportedly supporting the accusations of its claim charts, including SEMs, SCMs, and SIMS analyses"), but ignores that AOS has not only failed to provide anything similar, it has failed to cite to any evidence at all.

AOS chose to pursue its patent infringement claims in the Northern District of California, knowing full well that the Northern District Patent Local Rules impose on a plaintiff an obligation to disclose its infringement theories under Patent L.R. 3-1 prior to receiving any discovery. *See e.g., Network Caching Technology, LLC v. Novell, Inc.*, 2002 WL 32126128, *4 (N.D. Cal. 2002) (granting in part motion to strike PICs). Accordingly, AOS cannot rely on the fact that no discovery has occurred in this case to excuse its failure to provide PICs that disclose its infringement theories. Fairchild was similarly burdened with an obligation to disclose its infringement theories for the infringement claims it is pursuing against AOS, and has fully met that obligation, as stated above.

The other points in your letter are similarly untenable. Fairchild has identified in good faith the AOS products that Fairchild accuses of infringement in compliance with Patent L.R. 3-1(b) and (c). Your assertion that Fairchild has provided claim charts for only a "handful" (actually 14) of products attempts to impose on Fairchild a duty beyond what is required by the Patent Local Rules. Fairchild has more than adequately described in the PICs its basis for asserting infringement against all the products identified, based on a representative sample of AOS's products. Furthermore, contrary to your implication that Fairchild may accuse only products it identified in pre-litigation correspondence with AOS, Fairchild may accuse any product which it believes in good faith infringes its patent claims pursuant to its investigation of the factual and legal basis for its complaint. That is precisely what Fairchild has done.

Your assertion that Fairchild's disclosures under Patent L.R. 3-1(f) are not specific enough is also wrong. Patent L.R. 3-1(f) does not impose an obligation that the identification of a party's own instrumentalities that practice the claimed inventions be "as specific as possible," as Patent L.R. 3-1(b) does for the identification of accused instrumentalities. Patent L.R. 3-1(f) merely requires that the party "identify" such instrumentalities. Fairchild has clearly identified its products that practice the claimed inventions. Your assertion that Fairchild's exhibits provide insufficient information is also wrong. The Patent Local Rules require that the PICs provide fair

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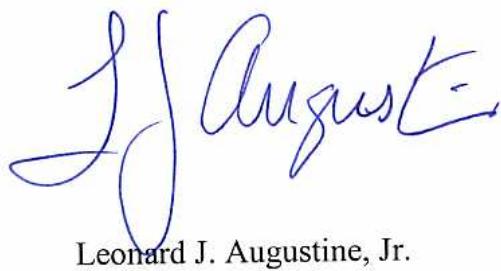
notice to AOS of Fairchild's theories of infringement. The provided disclosure, including the exhibits and the figures attached thereto, are in full compliance, including providing even information you assert is lacking.

We reiterate our previous request that you please provide amended PICs that fully comply with the requirements of the Patent Local Rules. As I stated in my September 12 letter, Fairchild's Preliminary Invalidity Contentions are due within 45 days of service of AOS's Preliminary Infringement Contentions, and we interpret that to mean service of contentions that comply with the Patent Local Rules. Please let us know by the end of the day on Thursday, September 27, 2007 a date certain in the near future by which you will provide fully compliant PICs. If you do not provide us such a date, we may be forced to seek appropriate relief from the Court.

Finally, you have asserted that "we suspect that at least one of the parts identified is not even an AOS product," while failing to identify such part. We request that you promptly identify such part, if any, including an explanation of why you assert it is not an AOS product.

We are available to meet and confer on these matters today or tomorrow. Please contact me by telephone at (650) 592-3114 if you wish to discuss these matters.

Regards,



Leonard J. Augustine, Jr.

LJA/lja

61162311 v2

61162311 v2

EXHIBIT 8

Augustine Jr., Leonard J.

From: Casillas, Esther
Sent: Wednesday, September 26, 2007 10:58 AM
To: 'bschuman@morganlewis.com'
Cc: Augustine Jr., Leonard J.; Shoiket, Igor
Subject: Emailed: AOS/Fairchild: Correspondence from LJAugustine to Awu re September 21, 2007 correspondence



2007-09-26
Augustine to Wu re ..

Attached find Mr. Augustine's letter dated today responding to your letter of September 21, 2007 re AOS's Disclosure of Asserted Claims and Preliminary Infringement Contentions pursuant to Patent L.R. 3-1 served on August 31, 2007.

If you have any questions, please contact Mr. Augustine directly.

Thank you.

Esther A. Casillas
Assistant to Paul F. Kirsch, Mehrnaz Boroumand Smith
and Leonard J. Augustine, Jr.
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